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Lighting of the New House of Commons

By C. DYKES BROWN, A.M.I.E.E. *(Fellow)*

Summary

Lighting, in common with the other services, has been designed as an integral part of the rebuilt House of Commons. The installation in the Debating Chamber is particularly interesting since the artistic requirements have been given first consideration, new techniques being evolved where necessary to meet these requirements. Cold cathode, high voltage lamps are used in the laylight providing the main illumination, and the lighting can be raised smoothly from zero to full intensity.

(1) Introduction

The last House of Commons was destroyed during an air raid in May, 1941. When plans were being prepared for the new House, considerable thought was given to the style and character which should be adopted. An opportunity had been created to depart from what had obtained in the old building, but the decision was nevertheless made to reintroduce the late Gothic style in harmony with the rest of the Palace of Westminster.

Although the new building has been erected on the original site, skilful planning by the Architect has resulted in many improved amenities. These include not only the provision of two floors below the Chamber, for the accommodation of Ministers' rooms, Members' Lounge, Conference rooms and others, but also an additional floor at the top of the new House. Increased accommodation has also been provided by increasing the size of the Galleries, and the total seating in the entire Chamber has risen from 802 to over 900.

In designing the new House, the Architect has retained the character and dignity of the old and at the same time eliminated some of the elaborate ornamentation which was predominant. Sir Giles Gilbert Scott in his report upon the proposed New House of Commons, stated: "The Gothic detail of the old Chamber was lifeless and uninteresting, and the richness was spread evenly over the whole area without relief or contrasts. It has been our endeavour to remedy this, with the result that, though still Gothic in style, the effect will be entirely different from what existed before." (1)

Every opportunity has been taken to introduce throughout the building the most modern methods for heating, ventilating, lighting and electrical services generally. Extensive tests and trials were carried out before final decisions were made and reference to some of those applicable to the lighting will be mentioned in this paper.

The keynote of the lighting throughout the House, and particularly in the Chamber, is that efficiency in terms of lumens per watt consumed has been largely subordinated to artistic needs, and this is perhaps the most interesting feature of the installation.

(2) The Chamber Lighting

(2.1) General Description

The seating arrangements of the Debating Chamber are similar to the original disposition, with benches facing each other across the floor of the House. Specially treated English oak has been used not only for the benches, but also for the roof, which slopes from the sides of the Chamber to a middle flat portion, and for the

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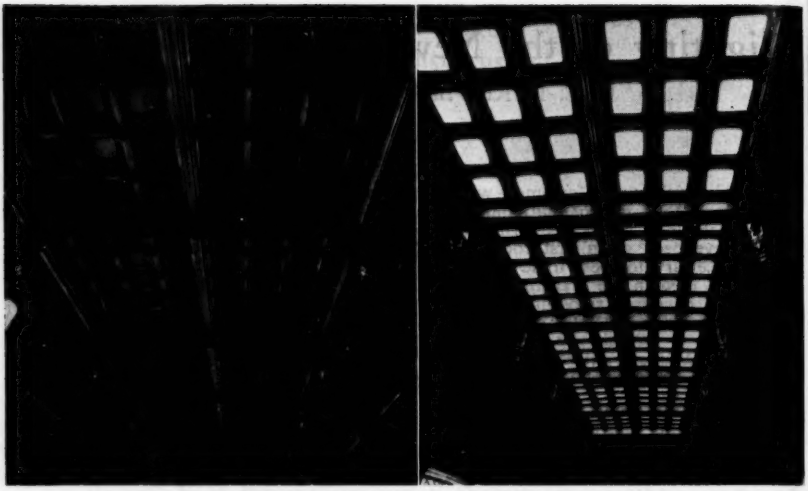

Fig. 1. Day and night view of the laylight in the Chamber.

extensive panelling of the walls above and below the Gallery. The main characteristic of the panels is to form a concentration of ornamentation having horizontal bands of rich carving with contrasting plain surfaces. Against these large areas of timber, light colour Clipsham stone has been used for the windows and masonry in the Gallery. The benches are upholstered in green, and the floor is covered with carpets of mottled brown-fawn colour to tone with the oakwork, except for the middle of the floor of the House, where the carpet is green.

(2.2) The Lighting Problem

As seats are distributed over much of the floor area and the whole of the Gallery, it is clear that a lighting system had to be devised which would ensure a good level of illumination in all parts of the Chamber. Natural lighting is admitted through the windows along the East and West walls above the Gallery, and during the periods when daylight could be used the Architect desired that there should be no evidence of the arrangements which had been made for artificial lighting. It was a further requirement that as the daylight waned the artificial lighting could be so controlled that at no time would its introduction be likely to distract a Member addressing the House.

(2.3) Chamber Ceiling

The central portion of the ceiling has been made in the form of a laylight consisting of five principal panels, each of these being sub-divided into thirty smaller panels. An ingenious illusion has been obtained by glazing these panels with a specially tinted glass, so that when the Chamber is lit by daylight from the side windows the whole of the roof and ceiling appear to be constructed of timber. (Fig. 1.)

The main source of artificial lighting is installed in the void above the ceiling, but as each of the 150 glazed panels is surrounded by a wide oak framework it was not possible to use light sources which covered more than one panel without

reducing very considerably the overall efficiency. Each panel has, therefore, been treated as a separate lighting unit.

Many difficulties had to be overcome before a suitable glass was found, the most important factors which had to be considered being :—

(i) The daylight appearance of the glazing had to bear a close resemblance to the oak roof.
(ii) The glazing had to be sufficiently diffusing to satisfactorily obscure the source of the light.
(iii) The light transmission factor had to be as high as possible.
(iv) Specular reflections in the front surface of the glass had to be avoided.
(v) The material used for the glazing had to be non-inflammable and unbreakable.

After numerous tests, during which no fewer than eleven different types of glass were carefully examined, a special three-ply glass was eventually selected. The correct colour was not obtained, however, without absorbing rather more of the light than would have been otherwise necessary.

(2.3.1) *Preliminary tests*

After a series of preliminary tests elsewhere a decision was made for an actual demonstration in the House of Commons, to consist of both hot and cold cathode lamps, and for this purpose 120 of the total 150 panels were used, 60 being equipped with hot cathode lamps and the remaining 60 with cold cathode lamps.

These large-scale tests to determine the type of lamp to be used were made when the Chamber was little more than a shell, presenting a scene of stone and concrete with no glazing in the windows. A temporary ceiling was constructed and fixed in the position which would ultimately be occupied by the permanent ceiling so that realistic effects could be obtained.

All the lamps were dimmer controlled, and particular attention was paid to the following points when assessing the relative merits:—

1. Comparative efficiencies.
2. Appearance of the lighted panels.
3 Ability to introduce light from zero and to dim from maximum to blackout.
4 Maintenance problems, with special reference to lamp life.

(2.3.2) *Comparison between hot and cold cathode lamps*

As can be seen by reference to Table I, there was little to choose between the efficiencies of the two lamps.

Table 1.

Comparison of hot cathode and cold cathode lamps for the ceiling in the Chamber.

	Hot Cathode	Cold Cathode
Total number of fluorescent lamps in laylight ...	600	150
Lamp efficiency lm/w. average throughout life ...	31	31
Approx. consumption per panel, including gear and dimmer losses (watts)	135	155
Average illumination at floor level at 100 hrs. (Lumens per sq. ft.)[1]	8	12½
Estimated number of lamps used in 10 years ...	2,400	150

The dimming of both systems was good, but it was generally felt that the results from the cold cathode were better. In the hot cathode scheme, each panel was

lighted by four 20-watt 2-ft. lamps, and in order to keep the gear losses as low as possible the lamps were operated in pairs with two in series. This arrangement had the disadvantage that the failure of one lamp meant that two would be extinguished. It was also inevitable that in time a succession of lamp failures would occur, each causing the uniform brightness of the ceiling to be marred by dark patches.

Compared with the 600 lamps in the hot cathode system, the cold cathode scheme used only 150 lamps. The much longer life of the cold cathode lamps and the smaller number used reduced considerably the likely incidence of failures. In fact, it has been estimated that since in an average year the main lighting in the Chamber may be in use for about 1,000 hours, lamp replacement should not be required for several years.

(2.4) Summer Controlled Circuits

Since very limited dimming only is obtained when one series resistance is used to control several fluorescent lamps, it was necessary to provide a method for varying the current in individual lamps. A separate variable resistance could be used for each circuit, but in this instance it would present many practical difficulties as in the Chamber a total of 243 fluorescent lamps, including hot cathode and cold cathode types, have to be dimmed.

The fluorescent lamp circuits, described later, with the exception of that for the Speaker's chair, include a transductor (or D.C. saturable choke) for each lamp. With this arrangement many lamps can be dimmed together by using one control such as a potentiometer to adjust the direct current in the control windings of the transductors. This method enabled a dimmer equipment with a minimum of moving parts to be installed.

(2.5) Description of Cold Cathode Scheme

The control of the lighting had to be smooth to ensure a steady uniform increase in illumination, and although it was realised that in practice the artificial lighting would be introduced while the Chamber was still partially lit by daylight, nevertheless it was desirable that the lighting should be raised from blackout without any perceptible hesitancy in any of the panels. Special circuits and equipment could be used to provide the degree of control of the fluorescent lamps necessary at the lower end of the range, but these were considered to be an uneconomical proposition. A compromise was therefore made using an auxiliary lamp circuit which could be controlled easily from zero [2].

Two tubular filament lamps are fitted in each of the 150 panels and baffled so that no direct light falls on the glazing. Each lamp is made in a special coloured glass to ensure that the appearance of the ceiling when lighted by the auxiliary lamps is similar to the effect from the fluorescent lamps.

The method of operation decided upon was to arrange for the auxiliary lamps in each panel to be controlled by a variable series resistor. When the lighting is required, the auxiliary lamps are switched on in the dim position and the brightness of the ceiling panels gradually increased as the dimmer resistor is slowly cut out of the circuit. At a predetermined position of the auxiliary dimmer, the cold cathode lamps are automatically switched on in the dim position; the intensity of the cold cathode lamps is then brought up steadily to its maximum.

At first it might be thought that the filament lamps used in the auxiliary circuit would have a short life compared to the 10,000 hours' life expected from the cold cathode lamps. The dimmer equipment, however, has been designed to cut off automatically the supply to the auxiliary circuit when the intensity of the cold cathode lamps attains about 25 per cent. of its full value. This means that the auxiliary circuit will be connected for a few seconds only each time the lighting is used, and

Fig. 2. General view of one of the cold cathode units.

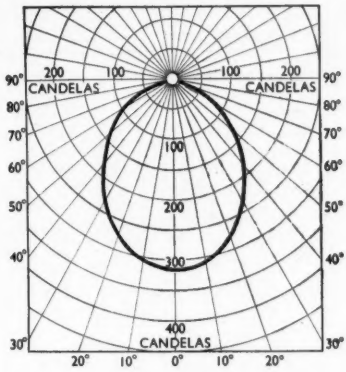

Fig. 3. Light distribution from the cold cathode unit.

it is expected that with this arrangement the useful life of the filament lamps will be very great.

(2.5.1.) *The Cold Cathode Units*

A self-contained lighting unit in the form of a sheet metal fitting which accommodates the cold cathode lamp and its associated gear is installed behind each of the 150 panels in the ceiling. This is divided into two compartments: the lower contains the lamp and also carries a dust-tight glazing frame in order to reduce maintenance work as much as possible, while the gear is fitted in the upper part. One of the units with the front glass removed is shown in Fig. 2.

The cold cathode lamp is 14 ft. 8 in. long, and is shaped in the form of a spiral to light the front glass evenly. It is supported on glass insulators, and the electrodes, which are at rightangles to the plane in which the tube lies, return through mica dust-tight glands into the gear compartment above. A considerable improvement in the appearance of the units at wide angles of view was obtained by fitting glass mirrors to the vertical sides. These also improved the light output ratio by about 10 per cent. A polar curve of the candle-power distribution in a vertical plane of one of the cold cathode units is shown in Fig 3.

Each unit is provided with a seven-core flexible cable terminating in a plug for connection to the distribution system in the roof. When the plug is withdrawn a fitting can be removed for cleaning or servicing and temporarily replaced by one of the spare units. An electrical interlock in the form of a double pole switch is incorporated in the cover of the upper compartment, which automatically disconnects the supply to the transformer when the cover is opened, thereby eliminating any danger during maintenance.

(2.5.2) *Lamp Circuit*

The high voltage required for the cold cathode lamps is obtained from double-wound transformers contained in the upper compartments of the fittings. A separate transformer is associated with each lamp and is designed to run the lamp at a maximum current of 120 ma.

Control of the lamp current, and hence the intensity, is obtained by using a transductor in the primary circuit, the direct current supply for this being provided by a small metal rectifier also in the fitting (3). The lamp is fully dimmed when no direct current is applied to the control winding of the transductor. Provision is made in the dimmer panel, for varying the D.C. by adjusting the input to the rectifier. When

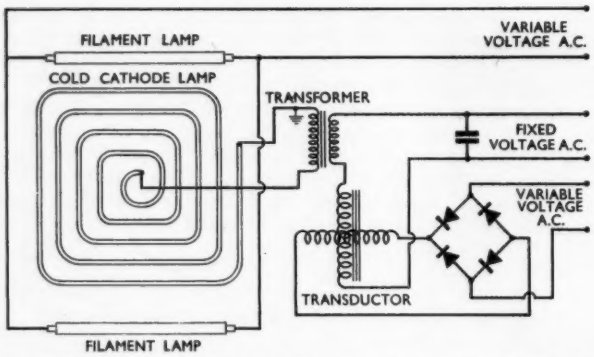

Fig. 4. Circuit diagram for cold cathode unit.

the D.C. voltage is increased, the core of the transductor becomes partly saturated, resulting in a reduction in the effective impedance in the circuit and a corresponding increase in the brightness of the lamp.

The general arrangement of circuits is shown in Fig. 4; the capacitor indicated in this diagram is for power-factor correction.

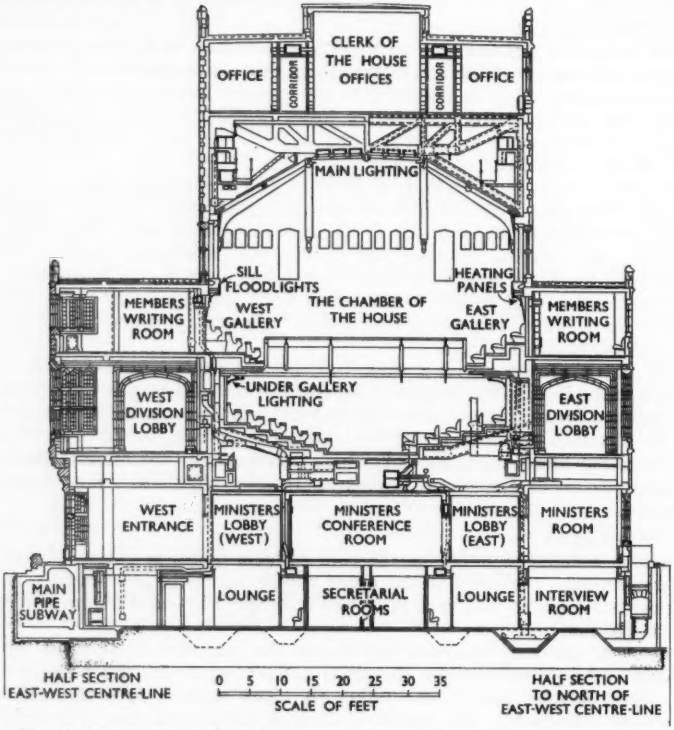

Fig. 5. Cross section through the House showing the lighting arrangements.

(2.6) Under-Gallery Lighting

It will be seen from Fig. 5 that the back row of benches on the floor of the House is partially screened by the gallery from direct light from the ceiling. Although sufficient light is available for reading, the faces of Members using these benches might not be seen clearly by the Speaker unless additional lighting were used. A special recess was therefore left in the underside of the front of the gallery to accommodate a line of fluorescent lamps along all four sides of the Chamber. The line of light is broken at intervals by beams on the underside of the gallery, which run at rightangles to the lamps.

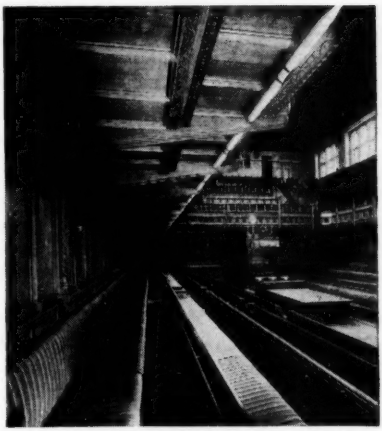

Fig. 6. Showing the lighting under the galleries.

With a few exceptions the space between the beams was sufficient to allow two 20-watt 2-ft. hot cathode fluorescent lamps to be fixed in line; these are recessed into the gallery and covered from view by obscured "Perspex." A total of 72 fluorescent lamps, four of these being 15-watt, 18-in., is installed under the gallery, and all are dimmer controlled. (Fig. 6.)

The same lighting channel has also been used for a system of secondary lighting which can be connected to an independent D.C. supply obtained from storage batteries. A 15-watt filament lamp is fitted between each pair of fluorescent lamps for this purpose and is concealed by a similar "Perspex" screen. The "Perspex" under the gallery is coloured to match the oak, and is consequently inconspicuous when the lamps are switched off.

(2.6.1) *Circuit Arrangements*

One set of control gear, consisting of transformer, choke, transductor and power-factor correction capacitor, is installed for each pair of lamps and housed in gear-boxes recessed in the floor of the gallery. As the lamps had to be dimmed it was necessary to use a system of control which maintained the available starting voltage and filament heating approximately constant over the complete range from dim to full brightness (4). The arrangement shown in Fig. 7(a) has been designed to provide adequate filament heating irrespective of the lamp current. When the lamps are operating at full brightness the electrodes are heated principally by the discharge, and, when dimmed, by the filament heating transformer.

The transductor used to vary the lamp current has been connected between the transformer and the lamps, since in this position it does not materially affect the maximum available starting voltage, and reliable starting is obtained at all settings of the dimmer.

The D.C. supply required for saturation of the transductor is obtained from a rectifier and controlled by a variable potentiometer in the main dimmer panel.

(2.7) Sill Lighting

Although the two systems of lighting already described constitute the main sources of illumination, a third system has been introduced so that the character and architecture of the Chamber may be better appreciated at night. This has been ingeniously concealed in the window sills along the east and west sides of the building. It serves

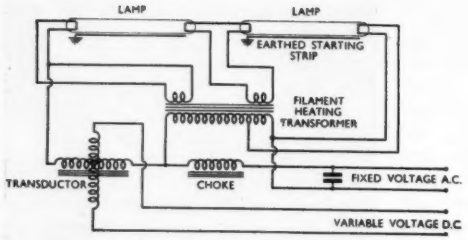

Fig. 7 (a). Circuit for the under-gallery lighting.

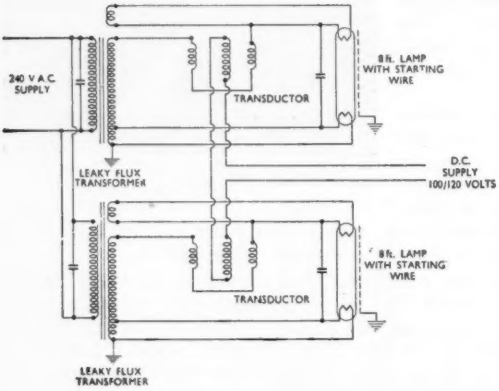

Fig. 7 (b). Circuit for the sill lighting.

two functions: (1) of lighting parts of the roof and ceiling which would otherwise be dark, and (2) of decreasing the contrast between the brightness of the glazed panels and that of the sloping portion of the roof.

Five lighting units are installed along each side of the Chamber, each being fitted with two 8-ft. 125-watt dimmer-controlled hot cathode lamps. The light is directed on to the half of the roof which is on the same side of the building as the units by means of specially designed reflectors. Since it is possible to look down on to the window sills from the highest part of the end galleries, louvres have been fitted over the units to conceal the lamps from these positions. The reflectors and louvres were also designed to prevent unwanted light falling on the sides of the windows and the open carved woodwork which runs along the front of the sills. Glass dust covers are provided on each unit.

(2.7.1) *Sill Lighting—Circuit*

It will be seen from Fig. 7 (b) that a double-wound stray field transformer is used to step up the supply voltage and to heat the lamp filaments, the lamp current being varied for dimming by means of a transductor inserted between the transformer and the lamp (4). One potentiometer in the dimmer panel controls the D.C. saturation of the 20 transductors installed for the sill lighting.

(2.8) Speaker's Chair

Although considered last from the lighting point of view, the focal point in the Chamber is the Speaker's chair.

A large canopy which projects from the back of the chair obstructs direct light

from the ceiling and an independent light source had to be provided. One 2-ft. 20-watt fluorescent lamp has been concealed in the top of the canopy and is switched on and off by a motor-operated resistance dimmer. A switch is fitted in one of the arm rests, giving personal control to the Speaker.

(2.9) Illumination Data

The average values of illumination which will be obtained in the Chamber over the 10,000 hours of life of the cold cathode lamps are shown in Figures 8a and b, and vary between 12 and 9 lumens per sq. ft. over most of the floor. Lower levels of illumination are obtained under the gallery but it is generally considered that adequate light is provided here. No harsh shadows are perceptible when all the lighting is on, and the gradation of brightness on walls and ceiling is pleasing and effective without being abrupt. (Fig. 9.)

"Intermediate" colour cold cathode lamps have been used above the laylight and warm white for under the gallery, giving the impression that the Chamber is flooded by sunlight without distorting the colour of the timber. A combination of mellow and natural lamps is used in the sills. Technical data concerning the installation in the Chamber are given in Table II.

(2.10) Electricity Supply System

The lighting is distributed across two separate 415/240-volt, 3-phase, 50-cycle, 4-wire services from the main switchboard, and secondary lighting is automatically connected to a 240-volt D.C. battery system should the A.C. supplies fail. Panels 1, 3, and 5 of the laylight are connected to a, b, and c respectively of Supply No. 1; panels 2 and 4 are connected to phases a and c respectively of Supply No. 2. The under gallery is on phase b of Supply No. 1, and sill lights are on phase b of Supply

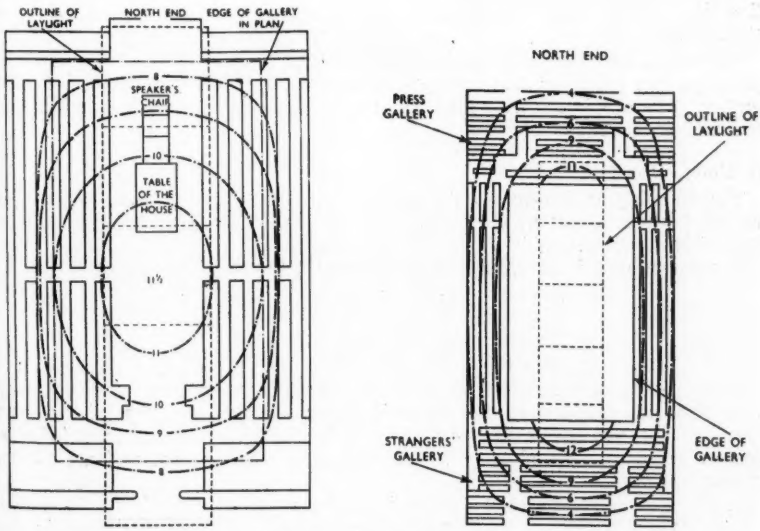

Fig. 8. Isophot diagram showing illumination in the Chamber (a) at main floor level, and (b) in the galleries. Illuminations are given in lm/ft.².

Table II.

Number of lamps, total consumption, and area lighted in the Chamber.

No. of cold cathode lamps	150
Consumption including gear losses (approx.) ...	24 kw.
No. of fluorescent lamps under Gallery	72
Consumption including gear losses	2.5 kw.
No. of lamps in window sills	20
Consumption including gear losses	3.2 kw.
Area of Chamber at floor level	3,060 sq. ft.
Area of Chamber at gallery level	4,944 sq. ft.
Height of ceiling above floor	48 ft.

No. 2. This arrangement of distribution ensures sufficient light in the House in the event of either supply failing. The emergency system, which includes the lamps under the gallery already referred to, and additional lamps under the sills, is always on as part of the main lighting, so that there would be no total interruption of the lights in the event of both the A.C. supplies failing.

(3) The Chamber—Control of Lighting

The lighting in the Chamber is normally switched on and off from the engineer's control room in the basement. A small control panel is fitted with push-button switches for remote control of the dimmers and fixed alongside the engineer's desk; these enable the engineer to increase or decrease the illumination as necessary. Indicator instruments are recessed into the panels to show the intensity of the main ceiling light, while coloured pilot lights show when the lamps under the gallery and in the sills are alight.

As the engineer has other services beside the lighting to control from this room, a periscope has been installed through which he can obtain a general view of the Chamber. The eyepiece is over his desk and the periscope head is some 60 ft. above in the roof of the Chamber.

(3.1) Dimmer Panel

The dimming equipment for the lighting in the Chamber is installed in a plant room on the same level as the ceiling and consists of four motor-driven dimmers contained in sheet steel cubicles.

A separate unit is provided for each of the following:—

Dimmer A—Ceiling panels 1, 3 and 5.
Dimmer B—Ceiling panels 2 and 4.
Dimmer C—Under gallery.
Dimmer D—Window sills.

Three push button switches are fitted on the front of the panel for each motor, two of these are for starting the motor in either direction, and the third stops the dimmers at any pre-determined or desired position. The push button switches and indicators are duplicates of those in the engineer's control room and are for local operation and testing.

In addition to the isolators for the incoming supplies and sub-circuits, switches are fitted to cut out the potentiometers if necessary. Hand wheels on the front of the panels are fitted with a change-over lever to disengage the motor drive and can be used to operate the dimmers manually in the event of motor failure. When

operated by the motors, the dimmer speed has been arranged to bring the lights from "of" to "full-on" in one minute.

(3.1.1) *Operation of Ceiling Dimmers*

Although the two dimmer banks for the ceiling lighting are independent they are normally operated together by pressing the corresponding push buttons at the same time. When the push button switches are closed to bring the lighting from the "off" position, the action is as follows:—

The dimmer arms commence to rotate and cause contactors to close in the auxiliary lamp circuits. As the resistance in series with the auxiliary lamps is gradually reduced, the brightness of the ceiling panels and the illumination in the

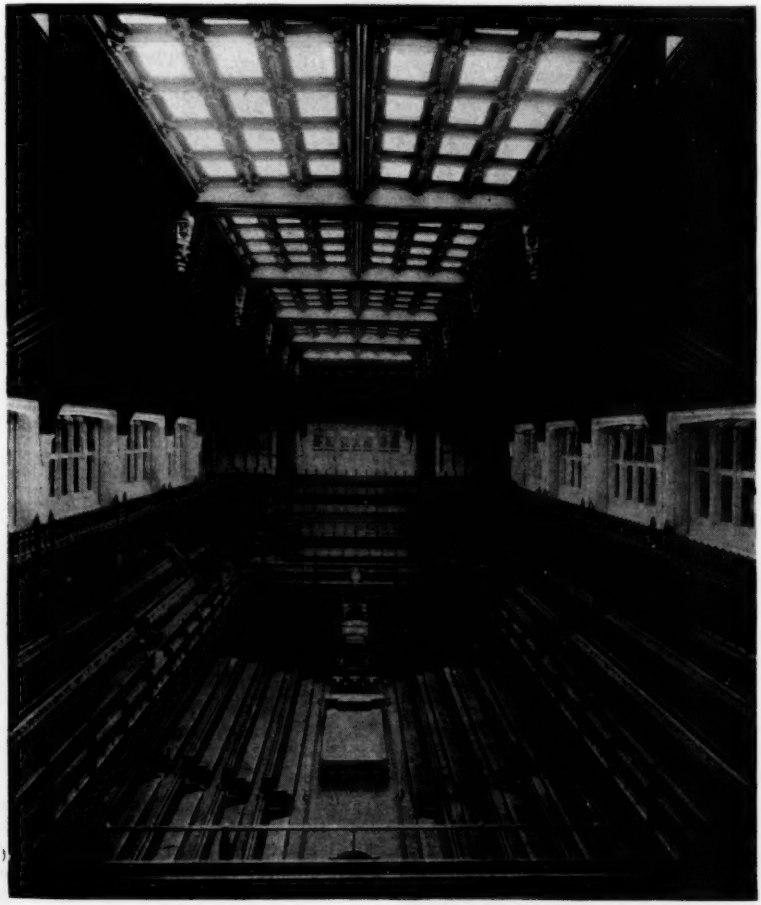

Fig. 9. Night view of the Chamber.

Chamber increase. When the auxiliary lamps attain full brilliance, other contactors close, connecting the supply to the transformers and rectifiers in the cold cathode lamp circuit. At this moment there is no excitation in the D.C. windings of the transductor and consequently the cold cathode lamps are operating at their lowest brightness. As the contact arms of the potentiometers rotate, the brightness of the cold cathode lamps increases, and when it has reached about 25 per cent. of the maximum, a trip switch automatically disconnects the auxiliary lamp circuits. Adjustable limit switches can be pre-set to stop the contact arms of the

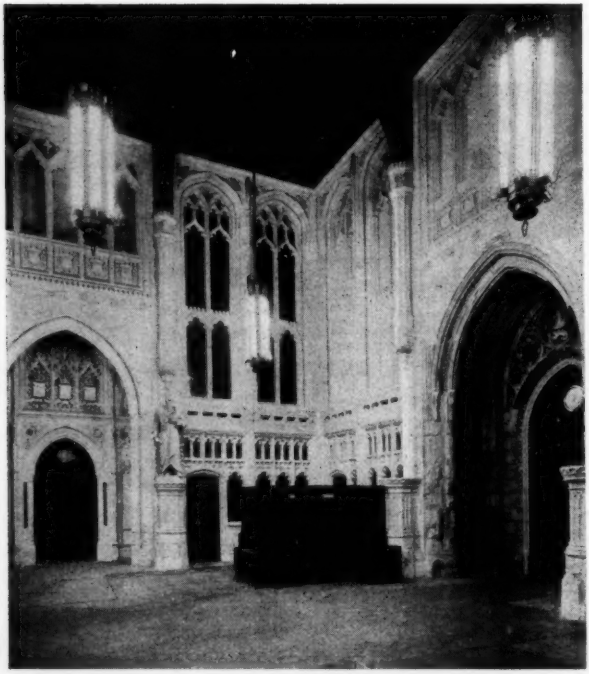

Fig. 10. The Commons Lobby.

potentiometers at any predetermined part of their travel, so that the normal maximum illumination can be adjusted to suit the requirements of those using the House and also to maintain the level of illumination as the lamps age.

When the "dim" buttons are pressed, the reverse sequence takes place and the auxiliary lamp circuits are reconnected as the cold cathode lamps are dimmed.

(3.1.2) *Under Gallery and Sill Dimmers*

The controlling elements of the under gallery and sill lighting are two variable potentiometers which are connected to the D.C. side of metal rectifiers. One of these controls the intensity of the 72 lamps installed under the gallery and the other the 20 lamps in the sills. The contactors which connect the supply to the filament-heating transformers close when the "up" buttons are pressed. As the contact arms of the potentiometers rotate, the cores of the transductors are saturated and the

lamp current increases. The potentiometers are also fitted with adjustable motor trip switches for automatically stopping the dimmers at different positions.

(4) Lighting in Other Parts of the Building

The artificial lighting in most other parts of the House of Commons follows conventional methods and a brief description only is given here. Over 400 spaces in the new building have had to be lighted, including conference rooms, interviewing and secretarial rooms, lobbies, plant rooms, lifts and others. Fluorescent lighting has been used extensively except in some situations such as staircases, telephone booths and some of the plant rooms, in which tungsten lighting has been installed.

(4.1) Commons Lobby

An interesting part of the building which called for special lighting arrangements was the Commons Lobby. On entering the lobby, one is immediately impressed by its height and it is apparent that a perpendicular type of lighting unit is required to harmonise with the architectural features. Five ornamental bronze fittings have been suspended from the ceiling and in addition to providing adequate general lighting, they enable the beauty of the windows and sculpture work to be fully appreciated (Fig. 10). Ten 40-watt fluorescent lamps are arranged vertically around the outside of each fitting. The fittings are provided with raising and lowering gear and are suspended so that the lowest part is about 15 ft. above the floor.

(4.2) Lobbies, Conference Rooms and Private Rooms

The lighting unit shown in Fig 11 is used in many of the rooms and lobbies. It is of bronze with open fretting on the sides allowing some direct light on the ceiling immediately around the fitting in addition to enhancing its general appearance. The lower part is covered with obscured " Perspex." To meet the requirements of the different situations where these fittings have been used, they have been made in various sizes, accommodating 18-in. 15-watt, 2-ft. 20-watt, 3-ft. 30-watt, or 4-ft. 40-watt, fluorescent lamps. Some are fitted with two lamps while others contain three or four. The gear tray and vitreous enamelled reflector are normally secured in the

Fig. 11. The type of fitting used in the Division Lobby showing the secondary lighting.

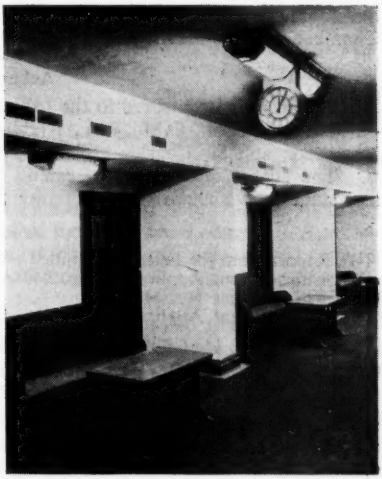

Fig. 12. *(Right)* A fitting in the Members' Lounge incorporating a clock.

top of the fitting, but to facilitate access to the control gear they can be suspended by four nylon cords as shown. Connection to the supply is made by means of a three-pin plug so that the tray and gear can be replaced easily if necessary. Some standardisation was achieved by arranging for the gear trays to be interchangeable in all fittings in which the same number and size of lamps are used.

Several lighting units are designed to serve a dual purpose; some conceal the outlets of the air-conditioning system, and others incorporate a clock as shown in Fig. 12.

(4·3) Lamps and Circuits

The fluorescent lamps throughout the House of Commons with the exception of the laylight in the Chamber are of the hot cathode type.

"Warm white" lamps have been used in the lobbies on the principal floor and "mellow" lamps in most other parts of the Members' accommodation. Natural colour lamps are installed in those plant rooms which are equipped with fluorescent lighting. Control gear to provide instant starting has been used in all fittings and stroboscopic effect is reduced by employing twin-lamp circuits in units containing two or more lamps.

Several of the lighting fittings also contain 15-watt filament lamps which are connected to the secondary supply system. These are accommodated in the end covers and are not normally apparent.

(5) Conclusion

So often the interior lighting of new buildings appears to be given less thought than the subject deserves, and schemes, sometimes far from ideal, may have to be devised when the building is in an advanced stage of completion. The House of Commons is a particularly interesting example of what can be done by co-operation between architect, consulting engineers and lighting engineers in so far as light sources harmonise with, and form integral parts of, the architecture.

Although Gothic in style and very different from the type of architecture usually associated with modern buildings, the House of Commons incorporates the latest techniques in lighting progress.

Now that the installation is complete, it is felt that the considerable amount of development work which had to be carried out, especially in connection with the Chamber, has justified itself by the results achieved.

Acknowledgements

The author is indebted to the following for permission to present this paper:—Sir Giles Gilbert Scott, O.M., R.A., Architect; Dr. Oscar Faber and Partners, Consulting Engineers; and Sir Charles Mole, M.V.O., Director General, Ministry of Works.

The author also wishes to extend his thanks to his colleagues especially for the assistance he has received in obtaining data on the completed installation.

References

(1) Report from the Select Committee on House of Commons (Rebuilding). (H.M.S.O.)
(2) British Patent Application No. 9404/49.
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(4) British Patent Application No. 27823/48.

Discussion

MR. J. R. KELL: The great defect of the Chamber before it was blitzed was the appalling contrast between the brilliantly lighted white panels in the ceiling and the very black oak which surrounded them and the darkness down the walls. In the Gallery the occupants had brilliant lighting above their heads but an empty darkness

down below into which they stared to see who was speaking; after half an hour of that they always got splitting headaches. The complaints of Members arose from the same reason. The Members were used to putting their feet on the Table or on the benches in front and staring upwards towards a brightly lighted ceiling, with jet blackness all around. That was why the illumination was tried first at an increased intensity and then reduced, but a satisfactory solution was never found.

The author has not referred to a part of the history of the new Chamber which might be called the tungsten versus fluorescent stage. When this project was first discussed in about 1945 those concerned thought only in terms of tungsten lighting. They had been instructed that one of the conditions was that the lighting must be capable of being dimmed so that there should not be a sudden change when Members were speaking and lights were called for even when Members were looking up. This requirement had to be fitted into the new design which, instead of as in the old Chamber having 64 panels about 4 ft. square, had 150 panels about 18 ins. square. At that time there was no conceivable scheme by which one thought of fluorescent lighting at all so that we started off thinking only of tungsten lighting. During the tests on air conditioning, a model was set up at Earl's Court of two full-size bays of the Chamber and tests were also made there on the lighting. Reflectors were tried out with tungsten lamps to get even illumination of the panels. Early tests with fluorescent lighting gave effects so dreadful the general feeling was against it, but later demonstrations, using the cold cathode fluorescent lamp in spiral form, completely altered the picture. A committee from the Ministry of Works, the Architects, the Consulting Engineers and many others saw the demonstrations, and I believe that everybody came to the conclusion that the fluorescent lighting was much to be preferred. I seem to recall that in comparison, the tungsten lamp gave a yellowish rusty kind of colour whereas the light from the fluorescent lamp was much fresher and much more pleasing both from the point of view of the stonework and the panelling. Also, for some reason, the diffusion was better: the tungsten lamps tended to be spotty, although that might have been due to the reflector design. At the same time, dimming had become practicable with fluorescent lamps so that the authorities agreed that fluorescent lighting should go ahead.

In the final scheme, upward reflected lighting was directed on to the oak roof, and that had been done bearing in mind the contrast in the old Chamber between the laylight and the oakwork. In the new Chamber, the oakwork was lighter colour, but even so the contrast might have been too great. The upward light made an important contribution to the finished result.

MR. J. L. ILSLEY: For historical interest I would like to mention a few of the lighting schemes that were tried out on full-scale models of the laylight and also, in some instances, in the Chamber itself during the course of construction.

One such scheme employed a single 150-watt internally mirrored reflector spot lamp behind each panel, the spot lamp being controlled by a resistance dimmer. A second scheme employed four 60-watt tungsten filament lamps and one 20-watt natural coloured fluorescent lamp, the tungsten lamps only being dimmed.

A third scheme employed four 20-watt fluorescent lamps in each laylight unit, operated in conjunction with four 60-watt bowl silvered tungsten filament lamps. A fully automatic motorised control unit gradually increased the light output from the tungsten lamps from zero to full output, and then switched on the fluorescent lamps in a pre-determined sequence, substituting them for an equivalent lumen output of tungsten filament light. The change over from the tungsten to the fluorescent lamps was made in sixteen steps over a period of about one minute, until each of the laylight panels was illuminated solely by the light from the four 20-watt fluorescent lamps. Each fluorescent lamp was separately controlled with its own instant-start gear, and the whole

sequence of operation took place automatically, in either forward or reverse cycles. In the original arrangement using etched Morocco glass in the laylight, the illumination was approximately 27 lm/sq. ft., but the coloured panels introduced considerable absorption. This system was demonstrated in the Chamber itself during the lighting trials early in 1949 and was a matter of historical interest because the change over from tungsten to fluorescent lighting was achieved completely automatically and smoothly. So far as I am aware this method of achieving dimming by the gradual substitution of the light from tungsten lamps by the light from fluorescent lamps is unique.

DR. J. N. ALDINGTON: It is well known to some of those who had worked on this scheme that plastic materials had been tried but had been rejected in favour of glass for the laylight in the main Chamber, although in the corridors and other parts of the Chamber plastic fittings had been allowed. Reasons behind the selection would be interesting.

In comparing the hot and cold cathode systems, the author has drawn attention to the fact that if one of the 20-watt lamps failed the light would be uneven, but that seems to be carrying the argument a little too far. In one system which was demonstrated there were four separately controlled fluorescent lamps and the failure of one of these would hardly be noticeable in the laylight, whereas the failure of one of the cold cathode lamps would result in complete blackout of a panel. It was hardly right, therefore, to suggest that incidence of lamp failure favoured the cold cathode scheme.

DR. J. W. STRANGE: In connection with the range of dimming, the paper states that the supply to the auxiliary filament lamp circuit is cut off at a certain point. It would be interesting to have figures for the actual contribution of the filament lamps to the general illumination at that particular point. It would also be interesting to have some information on the actual colour and spectral distribution of the light that gets through these rather unusual panels. The lamps are reported to be "Intermediate" in colour, but no indication is given as to the type of phosphor used. Is it the higher-efficiency type or is an attempt made to improve the colour rendering by using a "Natural"-type phosphor?

Reference was made in presenting the paper to a measured range of dimming of 500-to-1, which, it was stated, was found to be insufficient. This is surprising because in normal use it would appear that the lamps would be brought into use when the illumination on the main floor of the House was about 10 lm./sq. ft., and the additional illumination would be less than .02 lm./sq. ft. It would be useful to have more details of the final range of dimming achieved by the ceiling lights and also by the lamps under the gallery and on the sills.

MR. O. G. ELLIS: Is the power-factor correction altered by stages of dimming?

MR. F. T. MILNE: There is no provision for radio-interference; is this an omission?

MR. M. GAUGHAN: What is the absorption of the glass panels used in the laylight? I am glad to see that upward lighting is used. Nevertheless, I cannot help feeling that the contrast between the illuminated panels and the woodwork of the sloping portions of the roof is still higher than desirable.

MR. F. JACKSON: I have had the great privilege of seeing this installation, and I consider it first-class. It fits into the architecture in a way which I should have not thought possible. This is particularly true of the laylight.

MR. HARRISON JONES: Have any brightness measurements been taken, particularly of the laylight?

MR. M. HEALD: Why have glass panels been used in the main Chamber instead of louvres?

MR. HARRISON: I would like to draw attention to one or two points which the author, for lack of time, has not been able to cover. Mention has been made of the fact that lighting efficiency has been subordinated to effect, but I am sure the author does not mean that one cannot have both. Perhaps it would be better to say that the effect of the lighting is one of the main things that has been considered both by the designers and the architects. One could make all the calculations possible, but if the lighting does not satisfy the users of the building, it is not good lighting, and the author was quite right in emphasising that.

The treatment of the glass panels is another matter of interest because it is very difficult to get these panels looking all alike. On several occasions it was found that panels which were apparently identical gave quite different effects when illuminated, and they had to be matched meticulously.

One of the most important requirements was not only to light the floor of the Chamber, but at the same time to ensure reasonable illumination at the back of the galleries. The angle from the edge of the laylight to the floor of the house or side galleries is only some 20 degrees, but the angle to the back of the public gallery is more than 45 degrees. It would be interesting if the author would elaborate a little on the way the light is spread to the back of the galleries. In practice it did do that and the difficulty seems to have been satisfactorily overcome.

Tribute should be paid to the miracles of improvisation and ingenuity shown by the firms concerned, in putting up their various systems under difficult conditions. In all the systems tried, the dimming from zero was one of the greatest problems, and the solution of using both tungsten and fluorescent lamps is most ingenious and works very well. Perhaps the author would explain how the system, as installed, could be worked at lower intensities than the maximum, without the loss of energy usually associated with that condition. It is clearly a point of importance that the Members should not only be able to have the best light if they wanted it, but also some lesser light if they thought that more appropriate.

The safeguards against failure of the electrical supply go a little farther than mere emergency lighting, even though the latter extends throughout the corridors and public rooms of the building. Firstly, the switchboard which supplies the lighting is divided into two, so that the failure of one main feeder does not put the whole building in darkness. Then each floor has two fuseboards, one supplied from each source. Also, each of the large rooms, Division Lobbies, etc., has the lighting circuits interleaved so that failure of a fuse would put out only half the lights and leave enough light for movement. Finally, there is a purely emergency lighting system sufficient to enable the building to be evacuated in safety. In the old days it was necessary to "call for candles," but it was felt that the Members might expect some technical advance on this in the new House! The secondary lighting in the plant rooms goes a little further than in the corridors, being sufficient at least to allow the engineers to leave the plant in a safe condition. In the Control Room, where the alarm bells, signals, etc., are centred, there is enough emergency lighting to enable the control engineer to carry on with his job. The emergency lighting requires a modest amount of energy, the total battery capacity being less than 10 kw. This shows that an emergency system need be neither expensive nor elaborate to be effective.

MR. S. ANDERSON: The paper and discussion emphasise the great value of co-operation between the architect and the lighting engineer in problems of this sort.

Perhaps in no other recent instance has this co-operation been so complete as in the new House of Commons. It is to be hoped that other architects will realise that the happy results that have been achieved were largely due to that excellent co-operation on the part of the lighting engineers.

Mr. DYKES-BROWN (replying to the discussion): There are practical disadvantages to the scheme, using 60-watt filament lamps and 20-watt fluorescent lamps as mentioned by Mr. Ilsley. Apart from the fact that this arrangement would involve a total of 1,200 lamps for the 150 panels, the system would probably be operating for much of the time with the filament lamps only alight, as the dimmer controlling the main lighting in the Chamber is normally held in check to control the illumination at a level acceptable to those using the House. In these conditions the fluorescent lamps would be almost redundant, and the 600 filament lamps would have to be replaced much more frequently than the fluorescent lamps.

Plastic material was rejected for the ceiling in the Chamber because of a ruling which prohibited such material for roof lighting. There were no restrictions against its use for lighting fittings in other parts of the building.

The effect of lamp failures considered in the paper refer to a system of hot cathode lamps operating in pairs; if either of two such lamps failed, the panel would be apparent by its lower brightness. The effect would be less noticeable if each lamp were separately controlled, but in the system referred to by Dr. Aldington there were eight lamps in each panel and the incidence of failures would be considerably higher than in a cold cathode installation using fewer lamps with a very much longer life.

The auxiliary circuits in the main ceiling units contribute a maximum of 0.3 lm./ft.^{2} to the illumination on the floor of the House. The spectral distribution of the "intermediate" lamps used in the cold cathode units is between the well-known "warm white" and "daylight" lamps. (See H. G. Jenkins and J. N. Bowtell, Trans. Illum. Eng Soc. (Lond.), **13**, 61, 1948.) The glazing of the panels acts as a pale minus green filter and absorbs rather more than 50 per cent. of the incident light.

Although Dr. Strange was correct in assuming that the artificial lighting is normally switched on while the Chamber is partially lit by daylight, the acceptance tests were, nevertheless, judged by the appearance of the glazed panels when fully dimmed and not by the general effect of the light on the surroundings. It was found that a dimming ratio of 500 to 1 was insufficient to pass these tests. No figures are available of the final range of dimming obtained in the ceiling of the Chamber, but it would be safe to say that the range covered by the auxiliary and main lighting is well over 1,000 to 1.

Capacitors have been installed to maintain the power factor at not less than 0.85 over the working range of the dimmers. The capacity is not altered by stages during dimming.

No radio interference suppressors have been fitted to the dimmer controlled lamps in the Chamber. Tests made on site confirm that the installation comes within the limits of B.S.800; and it was believed that suppressors were not required because of the better current wave form obtained from the type of circuits in use. Radio interference suppressors have, however, been fitted to the fluorescent lamps throughout the remainder of the building.

Brightness measurements of the laylight and surroundings were made when the installation was completed, but not subsequently. The dimmers are set at present to stop automatically when the cold cathode lamps had attained about 80 per cent. full brightness. After making allowance for this and the fact that the lamps had aged, I estimate that when viewed from the front of the Distinguished Strangers' Gallery, the brightness of the nearest panels were now about 150 ft./L, the brightness of the vertical surface of the principal beams, 5 ft./L, and of the sloping portion of the roof, 1 ft./L.

Mr. Heald's suggestion to instal louvres in the ceiling panels had been tested. The

results were very disappointing, however, and hardly comparable to those obtained from the glazed panels. The floor of the House was brightly lighted, but the illumination at the back of the galleries, in particular the Press Gallery, was too low to be measured.

Provision of adequate lighting at the back of the end galleries, referred to by Mr. Harrison, had been a matter of some concern when the scheme was first devised. The position of the cold cathode lamp relative to the front glass and the help from the side mirrors had produced a wide beam angle which ensured sufficient light in these positions.

With resistance dimming the wattage consumption of the circuit remains practically constant when the lamps are dimmed and consequently a proportion of the energy is dissipated by the resistance. In the method using transductors, however, less energy is required in the control winding to maintain the lamp circuit below the maximum, and the wattage consumed in the circuit is almost proportional to the light output.

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